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# Safety Concerns of Startup Airlines

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## ABSTRACT

Startup air lines which do not have sufficient capital are forced to acquire older aircraft and contract out maintenance, crew training, and operation management. These factors can contribute to the poorly supervised practices as illustrated in this case study of the crash of a ValuJet DC-9 on May 11, 1996. The areas of focus are aircraft age, maintenance, safety record, cargo handling, and crew resource management.

## INTRODUCTION

This is a case study of a new airline company. This study details the demise of ValuJet flight 592. On May 11, 1996, a routine scheduled flight, with an experienced crew plummeted to the ground. One hundred ten people died in this crash.

In October 1993, ValuJet Airline was created with the use of only two aircraft. The airline has scheduled flights from Atlanta to Florida. When the airline started many analysts thought that it would not be able to compete with the major airlines. ValuJet has been able to compete by keeping costs low. They do this by having a ticketless system, no full meals, no first class, and a leisurely employee dress code. ValuJet has three different series of aircraft: the MD-80, DC9-30 and DC9-20. Within these series the airline flies three different models of the MD-80, two different models of the DC9-30 and two of the DC9-20.

According to ValuJet, "To put it less enigmatically, ValuJet's ValuFares can be as low as they are (from \$39 on many routes) because ValuJet's operating costs are among the lowest in the industry." Due to these cost cutting techniques the average one way fare is seventy-nine (79) dollars. In ValuJet's words, "ValuJet has been able to make a profit with less than half of the flight being full. All the mentioned cost cutting techniques enabled ValuJet to be the most successful startup company to date in the airline history."

This case study will focus on five areas of the airline operation that may have contributed to the demise of flight 592:

the excessive age of the aircraft, the maintenance practices performed on the aircraft, the safety aspects of the airline, the cargo the aircraft was carrying and the flight crew of the aircraft. In addition to these areas other airlines handling these duties are also reviewed.

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## DISCUSSION

The first area of concern is the age of the equipment. The plane that crashed on May 11, 1996, was purchased new in 1969 by Delta Airlines, traded back to its manufacturer in 1992 and bought by ValuJet in 1993 (Holman, 1996). "ValuJet's fleet is 26.4 years old on average, one of the oldest in the business, twice the age of the major airlines" (Holman, 1996). Some other startups have similarly aging fleets with the next closest one being 23 years (see Appendix A).

The age of ValuJet's DC-9 fleet is not unusual among major airlines that use the planes. Continental, Northwest, Trans World Airlines and USAir all operate dozens of DC-9s with an average age of 24 to 26 years. Instead of spending millions for new aircraft, many airlines choose to upgrade their older fleets. Although critical parts are constantly being replaced, aging airplanes can still pose safety threats.

For example, components such as engine and hydraulic systems may be replaced many times during regular maintenance schedules. An old plane also has other systems, including electrical wiring, that probably has not been replaced. This wiring can break down causing short circuits and fire aboard an aircraft. Older aircraft have their share of mishaps, flight delays, and breakdowns, but nothing as catastrophic as the ValuJet crash.

In most cases, the older aircraft in the inventory of the major airlines were purchased as new aircraft and have been maintained on a scheduled basis throughout their history. The aircraft in ValuJet's inventory were purchased used and are 25 years or more. The maintenance of the aircraft may be unknown.

Airlines purchase old aircraft because of the cost savings. They are inexpensive to buy. The average price of a new jetliner is \$25,000,000, considerably more expensive than a 20 year old airplane which may cost \$2,000,000. The reason most of the startup airlines aircraft are 20 years old plus is because the majors do not sell them until most of the useful life is gone or the aircraft become too costly to maintain. This is a potentially dangerous situation because the startup airlines purchase these used aircraft at a critical time in their life.

These aircraft need diligent maintenance to keep flying safely, which cost money in parts, labor, and downtime. Maintenance is contrary to the operations of any airline. Startup airlines may not maintain them as closely as a major airline would because they do not have the same cash flow. An aircraft on the ground does not create revenue. Besides the apparent economics, the startup airline may not do their own maintenance. A third party is contracted to do the work. The third party has even less concern with the aircraft. This could possibly lead to short cuts in maintenance. At a time when the aircraft needs more attention, maintenance cannot be jeopardized. ValuJet in mid-1996 operated (eleven) 11 different types of DC-9 aircraft. This contributed to the maintenance problems of ValuJet. Each type of aircraft needs different flight, maintenance, and cargo loading procedures. These procedures could easily be confused with each different type of aircraft.

The contracting out of the aircraft maintenance is the second area of concern to be considered. To maintain low costs, many start-up airlines like ValuJet not only buy used aircraft but also contract with other companies to do the heavy aircraft maintenance work on their jets. This practice is often referred to as outsourcing. The potential for mis-communication is inevitable. Many airlines prefer their own standard operating procedures (SOP) to that of another airline. Poor communication or different SOPs may have led to the May 11, 1996 crash of the ValuJet DC-9 north of Miami.

Different SOPs may have been a factor because maintenance practices of each airline differ. For example, one airline may top off all hydraulic systems and fill all tires with air after each flight. Other airlines may perform these simple maintenance procedures at the end of each day. The later procedure may lead to low quantities of fluids in the hydraulic system and low tire pressures at the end of the day, potentially causing major problems. Outsourcing also stretches the ability of the Federal Aviation Administration (FAA) to inspect and regulate this rapidly changing and growing industry.

The FAA is struggling to monitor an intricate web of contractors that stretches around the world. Internal FAA records show that on several occasions inspectors were concerned about a lack of oversight by ValuJet on its contractors. For example, an inspector found that maintenance was not properly documented by one contractor and that ValuJet lacked procedures to make sure it was done. The FAA also found that ValuJet did not make sure that the companies ValuJet contracted with — including other airlines like Northwest and Carnival — were properly trained using ValuJet's procedures. One company in particular that trained ValuJet pilots did not send to ValuJet records documenting poor performance or poor communication of the ValuJet employees, although this is one requirement of ValuJet.

A draft federal safety report related ValuJet Airline's quality control procedures at its contract maintenance facilities as inadequate five days before the crash of ValuJet Flight 592. The report cited out-of-date manuals, employees who were unfamiliar with various rules and work that were certified as completed when it had not even been started (Holman, 1996).

In one late February incident reported by the FAA, mechanics working for ValuJet in Atlanta used a hammer and a chisel to remove a balky DC-9 engine part being replaced. They did not have a Pratt & Whitney maintenance manual that would have told them a special tool was required for such work. Subsequently, on a flight to New Orleans shortly afterward, the engine lost oil pressure and shut down in flight. An FAA inspector was described as discovering that the chisel apparently had damaged a seal, letting engine oil drain out (Kuttner, 1996).

Sources have recently suggested that one of the FAA's main concerns about ValuJet's maintenance practices is the lack of standardization of its equipment and procedures. This ranges from cockpit and flight crew standardization to a lack of common practices at the various third-party maintenance operations

ValuJet uses. The FAA also cited concern about a corporate culture that is affecting and influencing the ability of aircraft captains to make safety-oriented decisions. The FAA is concerned that ValuJet paid pilots only for each leg of a flight, without any additional pay for extra time flown in the event of diversion and no pay whatsoever in the event a flight turns back. There are currently six firms that do maintenance work for ValuJet. Sabretech is one of the six companies that ValuJet hired to do heavy maintenance. ValuJet also contracted with more than a dozen other companies, including airlines, to work on its planes at various airports. This is cost effective for the airline but the people that are working on the aircraft for these maintenance subcontractors do not have the same level of motivation and feeling of ownership and involvement as the employees of an airline would have toward their own aircraft. If indifference exists, it could lead to skimping on maintenance practices. This may be the reason this plane had so many safety related problems.

Another area of concern is the safety record of ValuJet. ValuJet has been having its ups and downs since it began operating in October 1993 (Holman, 1996). ValuJet, once one of fastest growing companies in the industry has had problems with ongoing safety investigations with the FAA and the National Transportation Safety Board (NTSB). The safety record of ValuJet is of concern to the investigators. ValuJet has been involved in several accidents or incidents. It is this author's understanding that ValuJet had an accident and incident rate four times the industry average (Holman, 1996). Due to these safety concerns about ValuJet, the FAA conducted a seven-day safety investigation of the airline in February.

The aircraft involved in the crash had its share of service problems, nine to be exact. The safety record of the twenty-seven (27) year old plane revealed:

- September 1994, takeoff aborted because of takeoff warning horn and a high temperature warning light,
- May 1994 low oil pressure light caused flight to be aborted,
- May 1995 cabin depressurized in flight, flight was aborted,
- October 1995 aft stair was ajar, caused the flight to be aborted,
- January 3, 1996 engine overheated flight was aborted,
- January 4, 1996 takeoff warning light sounded causing flight abort, and
- January 20, 1996, hydraulic pressure low light flight was aborted.

In addition, there were 12 other safety related problems that ValuJet has experienced since it started flying in 1993.

The aircraft had nine reports of service problems since May 1994, including five requiring it to return to the airport after takeoff. Also records show that the airline filed 281 service difficulty reports with the FAA in just three years (Hedges & Cary, 1996). These reports are made voluntarily, and some airlines

report them more faithfully than others. Ironically, airlines that routinely submit service reports may have worse safety ratings than the less diligent carriers (Appendix B). The reason for these safety concerns, the FAA feels, is the outsourcing of contracted maintenance. ValuJet has agreed to make a major overhaul of its maintenance practices. ValuJet is also negotiating with several major airlines to take over most, if not all, heavy maintenance on ValuJet's fleet of DC9-30 aircraft (Holman, 1996).

The cargo being carried on the ValuJet Flight 592, is another major area of concern. The issue of the use of outside contractors arises again in this area ValuJet's dispute with Sabretech centers on the oxygen generators. Oxygen generators are connected to the oxygen masks located in the seat backs and are used by passengers if there is a drop in cabin pressure. Federal officials think that these generators could be the cause of the crash.

A generator, an 8 inch long stainless steel container roughly the size of a can of hair spray, produce oxygen by heating chemicals at close to 1,200 degrees Fahrenheit. The outside of the container reaches approximately 500 degrees Fahrenheit. The generators are activated when the firing pin is pulled, usually when a passenger pulls the oxygen mask from an overhead compartment or seat back. Sabretech, which is an FAA authorized maintenance company, removed the generators from ValuJet MD-80 aircraft that were undergoing maintenance.

ValuJet officials said they told the contractor to dispose of the generators. Sabretech said it was given no such order and put them in boxes, mislabeled them "OXY Canisters, Empty," and returned them to ValuJet. ValuJet then loaded the boxes into the cargo hold of flight 592. While the generators are standard equipment on many airplanes they are considered hazardous items when carried as cargo. The cargo hold of the DC-9 aircraft was carrying more than 130 of these generators back to its Atlanta headquarters. This cargo is suspect because of the indication of fire and smoke in the cabin and cockpit that was reported by the crew before the crash.

"ValuJet was not authorized to carry a cargo load of the oxygen generators that have come under suspicion" (Holman, 1996). ValuJet's chief operating officer, Lewis Jordan, gave an explanation on why the canisters were aboard the plane. Mr. Jordan stated, "the airline planned to refill them." This explanation does not seem adequate because other airlines, service companies and the biggest manufacturer of the devices say they do not refill the devices because it is not worth the effort to clean out the depleted chemicals (Matthew L. Wald, May 24). If there were an initiating source, the oxygen generators could enrich the air supply. Potentially enriched air could start a fire, via spontaneous combustion.

A fire that destroyed a DC-10 jumbo jet at Chicago's O'Hare International Airport 10 years ago was blamed on a generator that accidentally began producing oxygen in the cargo hold. While no lives were lost in that accident, the accident caused the FAA to classify the canisters as a hazardous material. When installed, the generators are heavily insulated to protect the plane from damage or fire from the intense heat produced when activated. Experts agree it is virtu-

ally impossible for the generators to malfunction, citing tests where the devices have been thrown on the floor and jostled without problems.

These canisters were being shipped without the protective caps that block them from being set off. The generators had been removed from other ValuJet planes by a contractor after their shelf life had expired, but they had not been lit-off or fired, meaning that the oxygen-producing chemical reaction had not been set off (Wald, 1996). The simple step of "firing" the canisters would have changed them from being a hazard capable of starting fires to a chemical compound that can no longer burn or explode.

The oxygen generators were placed on top of three fully inflated aircraft tires that were also being transported in the forward cargo hold of the aircraft. During takeoff these tires or possibly some other cargo shifted, hitting the box containing the oxygen generators. At least one canister was fired off or leaked oxygen causing the generator to heat up, setting off a chain reaction with the canisters in the box. This was confirmed by the discovery of two canister end caps that showed evidence of heat damage. Senator Bob Graham, D-FL, was quoted, "The canisters I saw were all charred and twisted by the heat." The activation of the generators and the heat produced, could have caused the tires to burn and explode.

This assumption is also supported by the traces of heavy soot found on some of the wreckage and by melted parts which confirmed a fire. Aviation experts believe that toxic gases produced by a fire involving the burning rubber of the aircraft tires and the canisters enriching the air supply (an analogy to an oxyacetylene torch where the oxygen enriches the burning mixture) would have killed everyone on board before the plane crashed into the Everglades.

Due to these findings, the NTSB called on the FAA to impose tough curbs on the air transport of such materials. A bipartisan group of congressmen introduced legislation to regulate the air transport of chemical oxygen materials, a suspected cause of the crash of ValuJet flight 592. Under this bill the FAA would be required to comply with the safety board's recommendations. The bill would ban shipments of chemical oxygen generators on passenger and cargo planes and the shipment of oxidizer and oxidizing materials in cargo bays not equipped with fire or smoke detector systems and an automated fire fighting system. The department of transportation has already banned the transport of oxygen generators on passenger carriers for the remainder of the year, pending evaluation of their safety (Holman, 1996).

The final area of concern is the crew of the aircraft. The pilot of the aircraft, Candalyn Kubeck, 35 years old, had been flying since she was 15 years old. She had nearly 9,000 hours of flight time, including 2,100 hours with ValuJet. She was very experienced, very well trained, and very competent. The co-pilot, had 2,000 hours of flight experience. In addition to the pilot and co-pilot there were also three (3) flight attendants on board.

The average age of all ValuJet pilots is 39 years old. The average overall flight time is 7,800 hours. This meets the industry standard experience for airline

pilots. ValuJet's pilot training is contracted out to other companies because it is more cost effective. As mentioned before, most of the major airlines do their own training. The fact that ValuJet contracts out their pilot training brings us to the point that a set standard procedure to deal with emergency situations may not be incorporated in this training. Seventy percent of accidents on air carriers are caused by human mistakes. Big airlines have minimized those inevitable mistakes with strong policies, hammered home through training, checklists and prescribed emergency procedures.

The two pilots in the ValuJet DC-9 aircraft had sufficient experience to handle emergency situations. This was confirmed by the investigators who reviewed the cockpit data voice recorder.

As mentioned before, these investigators stated evidence that there might have been an explosion on board. This was followed by the pilot radioing for clearance to return to the airport. Another indication on the cockpit voice recorder was the sound of wind rushing into the cockpit. This is an indication that a window had been opened to help clear the cockpit of smoke. This is a standard procedure all pilots adhere to during emergency situations of this type. This indicates that the crew took prompt action. The crash occurred seven (7) minutes later. Indications were that the crew and/or passengers may have passed out from the smoke. Based on eyewitness reports, the angle that the plane nosedived into the Everglades never varied, indicating that the crew was obviously incapacitated.

## CONCLUSION

ValuJet flight 592 was the victim of very bad luck. The oxygen generators that were carried in the cargo forward cargo bay normally would not have caused any problems in this location. The combination of the other cargo located there, and the method in which the generators were stored led to a generator igniting. This heat started burning the rubber on the tires, causing the tires to explode and the fire to spread throughout the forward cargo bay. This, in turn, caused more of the generators to ignite enriching the air supply and causing the fire to spread very fast and ignite other cargo in the hold. The acrid black toxic sooty smoke traveled up the cargo bays fiberglass panels into the cabin.

This sequence happened extremely fast because of the enriched oxygen supply in the air. The passengers and the pilots were incapacitated within ten minutes. The autopilot was turned off because of the emergency turn in progress at the time. The emergency oxygen masks in the cockpit may not have been working so the pilots were not getting the air they needed. When the pilots lost consciousness the plane crashed to the ground.

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### APPENDIX A US MAJORS AGE OF AIRLINERS

	<i>No. of A/C</i>	<i>Avg. Fleet Age (Feb.1996)</i>
<b>Carrier:</b>		
Southwest	226	8.3 years
American	664	9.2
American West	93	10.1
Delta	539	11.5
US Air	434	12.3
Continental	299	13.9
Northwest	389	19.1
United	577	21.0
<b>US Startups:</b>		
Reno	24	5.8
Western Pacific	12	10.3
Carnival	23	13.5
Air South	8	22.0
Frontier	7	22.6
Kiwi	16	22.8
Vanguard	8	23.0
ValuJet	40	26.4

**APPENDIX B**  
**AN AIR SAFETY REPORT CARD**

	<i>Problems per 100,000 Departures</i>	<i># of Accidents/ Incidents/Service Reports</i>
<b>Majors 1993-95</b>		
Northwest Airlines	55.5	0/60/855
Delta Airlines	51.7	7/135/1,364
Continental Airlines	33.3	5/90/394
America West Airlines	30.3	0/11/159
Trans World Airlines	29.1	1/28/209
Alaska Airlines	18.4	0/11/60
USAir	16.2	2/80/328
United Airlines	13.5	3/65/236
American Airlines	9.9	4/118/140
Southwest Airlines	8.8	0/19/137
<b>Group Average</b>	<b>26.7</b>	<b>2.2/61.7/388.2</b>
<b>Regionals/Commuters</b>		
Comair (Delta Connection)	113.0	0/17/677
Trans States Airlines	62.9	0/11/209
Continental Express	62.1	0/15/420
WestAir	47.4	0/15/206
Great Lakes Aviation	36.7	0/15/127
Piedmont Airlines	31.9	0/5/131
Express Airlines	31.2	2/36/64
Business Express	26.7	0/16/109
Simmons Airlines	22.4	2/19/110
Horizon Air Industries	21.2	1/17/113
Wings West Airlines	21.0	0/10/66
Flagship Airlines	19.8	1/30/111
SkyWest Airlines	14.6	0/12/66
Atlantic Southeast Airlines	6.6	1/6/33
Mesa Airlines	6.3	1/20/45
<b>Group Average</b>	<b>34.9</b>	<b>0.5/16.3/165.8</b>
<b>Start-Ups 1994-95</b>		
Nations Air Express	57.3	0/0/2
Spirit Airlines	45.0	0/1/4
ValuJet	39.0	2/5/31
Kiwi International Airlines	37.5	0/2/11
Reno Air	35.2	0/4/28
Air South	24.9	0/2/4
Midway Airlines	21.1	0/1/6
Carnival Airlines	19.0	1/3/1
Frontier Airlines	10.0	0/2/0
Air Tran Airlines	0	0/0/0
Vanguard Airlines	0	0/0/0
Western Pacific Airlines	0	0/0/0
<b>Group Average</b>	<b>24.1</b>	<b>0.3/1.7/7.3</b>